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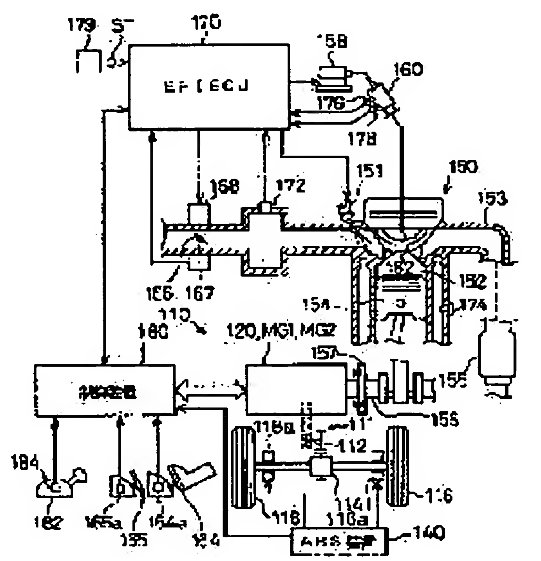
(54) POWER OUTPUT DEVICE, AND STOPPING METHOD FOR PRIME MOVER THEREIN

(57)Abstract:
PROBLEM TO BE SOLVED: To determine materialization of an executing condition for stopping time control to reduce an engine speed to zero with a prescribed deceleration in a power output device used in a hybrid vehicle.
SOLUTION: This power output device 110 is provided with a planetary gear 120, an engine 150 coupled with a crankshaft 156 to its planetary carrier, and a motor MG1 mounted on a sun gear. The engine 150 is not stopped immediately even when operation of the engine 150 is not required already to be continued because of a SOC of a battery or the like, but, for example, processing to stop the speed of the engine 150 with a prescribed deceleration is executed only when an ABS device 140 is not operated, cancel for reaction force is allowed, and a vehicle speed is within a prescribed range. The engine is stopped without feeling a reaction shock accompanied with the engine stop.



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CLAIMS

[Claim(s)]
[Claim 1] The torque control means which controls torque which is infixed between the prime mover which outputs power by combustion of a fuel, and the output shaft of this prime mover and a driving shaft, and is outputted to this driving shaft, It is the power output unit equipped with the motor which can output and input power to this torque control means. When it is judged that it is not necessary determine the operational status of said prime mover and to continue operation of this prime mover based on the demand to a power output unit A prime-mover operational status decision means to output the shutdown demand which suspends operation of this prime mover, Whether the conditions that said prime mover can be suspended are satisfied by seeing from a power output unit or the device relevant to this with a condition precedent judging means to judge, and said prime-mover operational status decision means When judged with the shutdown demand of the prime mover under operation having been outputted, and the conditions that this prime mover can be suspended being satisfied with said condition precedent judging means The power output unit equipped with a halt tense activation means to perform control at the time of a halt which adds torque to said output shaft, controls the rotation deceleration of this output shaft in the predetermined range, and suspends said prime mover while suspending the fuel supply to a prime mover.
[Claim 2] Said condition precedent judging means is a power output unit according to claim 1 which is a means to judge with the conditions which said prime mover can stop not being satisfied when the pre-heating condition of said prime mover is not completed.
[Claim 3] Said condition precedent judging means is a power output unit according to claim 1 which is a means to judge with the conditions of said prime mover which can be stopped not being satisfied when other power controls combined with said driving shaft are working.
[Claim 4] It is the power output unit which is a power output unit according to claim 3, and is a means for the wheel to be combined with said driving shaft, and for the slip arrester which prevents a superfluous slip of this wheel as a power control besides the above to be combined with this driving shaft, and to judge with the conditions of said prime mover which can be stopped not being satisfied when this slip arrester of said condition precedent judging means is working.
[Claim 5] Said condition precedent judging means is a power output unit according to claim 1 which is a means to judge with the conditions which said prime mover can stop when judged with the conditions that the reaction force which may be produced in said driving shaft can be reduced being fulfilled in case a prime mover stops being satisfied.
[Claim 6] It is the power output unit which is a power output unit according to claim 5, and is a means to judge with the conditions that said reaction force can be reduced when the wheel is combined with said driving shaft, the damping device which brakes this wheel is combined with this driving shaft and said damping device of said condition precedent judging means is working being fulfilled.
[Claim 7] It is the power output unit which is a power output unit according to claim 5, and is a means for the 2nd motor with which said motors differ to be combined with said driving shaft, and to judge with the conditions that said reaction force can be reduced when said condition

precedent judging means has this 2nd motor in the condition in which an output is possible to said driving shaft in the torque which reduces said reaction force being fulfilled.
[Claim 8] The output shaft of said prime mover is a power output unit which is a power output unit according to claim 1, and is a means to judge with the conditions which said prime mover can stop when said condition precedent judging means rotates said driving shaft to hard flow with this 2nd motor to said driving shaft by combining the 2nd motor with which said motors differ being satisfied.
[Claim 9] It is the power output unit equipped with a 3 shaft type power I/O means to output and input the power which becomes settled based on the power outputted and this inputted to one residual shaft when said torque control means has three shafts with which said driving shaft, said output shaft, and revolving shaft of said motor are combined, respectively and power is outputted [it was a power output unit according to claim 1, and] and inputted among these three shafts to any 2 shafts.
[Claim 10] The torque control means which controls torque which is infixed between the prime mover which outputs power by combustion of a fuel, and the output shaft of this prime mover and a driving shaft, and is outputted to this driving shaft, In the power output unit equipped with the motor which can output and input power to this torque control means Are the approach of suspending said prime mover, and it is based on the demand to a power output unit. Determine the operational status of said prime mover and the existence of the need of continuing operation of this prime mover is judged. See from a power output unit or the device relevant to this, and it judges whether the conditions that said prime mover can be suspended are satisfied. When judged with the conditions that it is judged that it is not necessary to continue operation of the prime mover under said operation, and this prime mover can be suspended being satisfied The halt approach of the prime mover in the power output unit which performs control at the time of a halt which adds torque to said output shaft, controls the rotation deceleration of this output shaft in the predetermined range, and suspends said prime mover while suspending the fuel supply to a prime mover.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the power output unit which controls a halt of a prime mover, and its approach in detail about the halt approach of a power output unit and the prime mover in the power output unit.
[0002]
[Description of the Prior Art] Conventionally, by the vehicle or vessel, the prime mover which outputs power by combustion of a fuel is carried, and the power output unit which carries out torque conversion of the power from this prime mover, and is outputted to a driving shaft is used. The thing which comes to combine the torque converter using a fluid and a change gear as such a power output unit is put in practical use. The torque converter in this equipment transmits power between both shafts through a flow of the fluid which has been arranged and was enclosed between the revolving shafts combined with the output shaft and change gear of a prime mover. In such a torque converter, in order to transmit power by flow of a fluid, slipping arises among both shafts and the energy loss according to this slipping occurs. Correctly, this energy loss is expressed with a product with the torque then delivered the rotational frequency difference of both shafts to the output shaft of power, and is consumed as heat.
[0003] Therefore, by the car carrying such a power output unit, when large power was required like [when slipping between both shafts becomes large (for example, when running the time of start, and ascent inclination at a low speed)], there was a problem that the energy loss in a torque converter became large, and became what has low energy efficiency. Moreover, since the transmission efficiency of the power in a torque converter does not become 100% even if it is at the stationary transit time, for example compared with the transmission of manual system, the fuel consumption cannot but become low.
[0004] Then, the power output unit which replaces the torque converter using such a fluid is already proposed partly. For example, the applicant had a prime mover, the planetary gear as a 3 shaft type power I/O means, two motors, and dc-batteries, did energy conversion to desired power with two motors by having used as planetary gear power stored in the power outputted from a prime mover, or a dc-battery, and has proposed what outputs this to a driving shaft (the Provisional-Publication-No. No. 30223 [50 to] official report). Moreover, in a power output unit equipped with such a prime mover and planetary gear, two motors, and dc-batteries (rechargeable battery), since desired power is stabilized and outputted to a driving shaft, based on these rotational frequencies, what carries out drive control of the two motors has been proposed so that the rotational frequency of the sun gear of planetary gear, or a ring wheel and three shafts of a planetary carrier may turn into a desired rotational frequency (Japanese Patent Application No. No. 274112 [eight to]).
[0005] The energy which the prime mover outputted is stored in the dc-battery, and since power can be carried out at any time and it can output, it is not necessary to make the power and the output of a prime mover which are outputted to a driving shaft not necessarily balance in these power output units. a prime mover be operate by the most efficient steady operational status , rather , if excessive energy exist to the power demand of the driving shaft , this will be store

with the gestalt of power , and if a battery be fully charge , a prime mover will be suspend , and from the point that constitute so that it may be make to run a vehicle only under the power of a motor make the whole system efficient , it be consider a desirable thing . In this case, on-off operation of the prime mover will be carried out.

[0006]

[Problem(s) to be Solved by the Invention] However, when the power output unit which actually combined the torque inverter between such prime movers and driving shafts was manufactured and a prime mover was operated intermittently, it turned out that various problems exist. The problem that one might cause torsion resonance since the torque inverter which has quite big mass is combined with the output shaft of a prime mover was found out first. And it was found out that the generating conditions of torsion resonance are influenced according to the pre-heating condition of a prime mover etc. Furthermore, peripheral devices, such as a catalyst, were variously connected to the prime mover, and it was found out that fault may arise when the prime mover was operated and suspended regardless of these conditions. For example, when the prime mover was suspended before completion of pre-heating, the catalyst never reached activity temperature but it was possible to continue operating a vehicle, while exhaust air purification has been inadequate.

[0007] Furthermore, the following problem was also found out. With the configuration using planetary gear, since the direct output of a part of power outputted from a prime mover is carried out to a driving shaft through planetary gear, if the fuel for a prime mover is cut, the rotational frequency of the output shaft of a prime mover will also change with sudden change of the power outputted from a prime mover. Change of the rotational frequency of such an output shaft is reflected also in the revolving shaft of two motors through planetary gear. Feedback control is carried out so that change of such an engine speed may be negated, but since the change of the power outputted from a prime mover to control of this motor of two motors is earlier, a torque shock will produce them in a driving shaft. The torque shock produced in the driving shaft is not desirable from a viewpoint of a degree of comfort.

[0008] Moreover, other power controls, such as an anti-lock brake system (ABS) which prevents a superfluous slip of a wheel, and a traction control, may be combined with the driving shaft of a vehicle. It is not desirable for such control to be control of the driving force of a wheel fundamentally, to suspend a prime mover in the midst of this control, since it is equal to performing the torque control of a driving shaft, and to change the torque transmitted to a driving shaft, if it sees from control of other power controls, and it had the problem that control was complicated.

[0009] In addition, the various problems accompanying the control which suspends a prime mover are found out, this invention solves such various problems, and it sets to one of the purposes to reduce the torque shock which may be produced in a driving shaft with a halt of a prime mover for the purpose of performing shutdown control of the prime mover in a power output unit proper.

[0010]

[The means for solving a technical problem, and its operation and effectiveness] The approach of suspending the power output unit of this invention and its prime mover took the following means, in order to attain a part of above-mentioned purpose [at least]. Namely, the prime mover to which the power output unit of this invention outputs power by combustion of a fuel, The torque control means which controls torque which is infixed between the output shaft of this prime mover, and a driving shaft, and is outputted to this driving shaft, It is the power output unit equipped with the motor which can output and input power to this torque control means. When it is judged that it is not necessary determine the operational status of said prime mover and to continue operation of this prime mover based on the demand to a power output unit A prime-mover operational status decision means to output the shutdown demand which suspends operation of this prime mover, Whether the conditions that this prime mover can be suspended are satisfied by seeing from a power output unit or the device relevant to this with a condition precedent judging means to judge, and said prime-mover operational status decision means When judged with the shutdown demand of the prime mover under operation having been

outputted, and the conditions that this prime mover can be suspended being satisfied with said condition precedent judging means While suspending the fuel supply to a prime mover, let it be a summary to have had a halt tense activation means to perform control at the time of a halt which adds torque to said output shaft, controls the rotation deceleration of this output shaft in the predetermined range, and suspends said prime mover.
[0011] When it is judged according to this power output unit that it is not necessary to continue operation about the operational status of a prime mover, operation of a prime mover is not suspended simply, but with the condition precedent judging means, only when it judges whether the conditions that operation of a prime mover can be suspended are satisfied and the conditions that operation of a prime mover can be suspended are satisfied, control is performed at the time of a halt of a prime mover. Control is control which controls the rotation deceleration (acceleration of minus) of the output shaft of a prime mover in the predetermined range, and it not only suspends the fuel supply to a prime mover, but suspends a prime mover at the time of a halt of a prime mover.
[0012] Consequently, when not affecting a power output unit and the device relevant to this, a prime mover passes through the field of the operational status which twists to that output shaft and produces resonance quickly, and stops.
[0013] The pre-heating condition of a prime mover can be considered as conditions which such a prime mover can stop. When pre-heating is not completed, it judges with the conditions which a prime mover can stop not being satisfied. From the demand to a power output unit, since operation of a prime mover is continued when the pre-heating of a prime mover is not completed even if it becomes unnecessary to continue operation of a prime mover, pre-heating of catalyst equipment can fully be performed, for example, and exhaust air purification nature is not spoiled. Moreover, with this configuration, although it may be difficult for the friction of a prime mover to be large and to control the rotation deceleration of the output shaft of a prime mover in the predetermined range, since the lubricity of a prime mover is inadequate, if it is before pre-heating completion, since a prime mover is suspended after completing pre-heating, a prime mover can be suspended controlling rotation deceleration in the predetermined range, and the problem of torsion resonance can be avoided.
[0014] Moreover, in the above-mentioned configuration, it is also possible to make a condition precedent judging means into a means to judge with the conditions of a prime mover which can be stopped not being satisfied, when other power controls combined with the driving shaft are working. In this case, it has not been said that the power with which they are outputted to a driving shaft since other power controls do not suspend a prime mover working is not changed, and actuation of other power plants is affected.
[0015] For example, the slip arrester which prevents a superfluous slip of a wheel as other power controls carried out like this can be considered. In this case, when a condition precedent judging means has a working slip arrester, it judges with the conditions of said prime mover which can be stopped not being satisfied. Therefore, while a slip arrester operates and controlling the torque of a wheel, it has not been said that a prime mover is not suspended, the torque fluctuation accompanying a halt of a prime mover arises in a driving shaft, and contention is produced between control of a slip arrester.
[0016] On the other hand, it can be judged positively that the conditions on which a condition precedent judging means can suspend a prime mover are satisfied. What is necessary is just to judge with a prime mover being suspended, when the conditions which can reduce the reaction force produced in a driving shaft with a halt of a prime mover are satisfied. For example, it can judge with the conditions that reaction force can be reduced being fulfilled by the driving shaft in the configuration with which the damping device which brakes a wheel and a wheel is combined, when a damping device is working. Since damping force has joined the driving shaft, the effect of reaction force can be reduced with this damping force.
[0017] Moreover, the configuration which reduces positively the reaction force which joins a driving shaft is also possible. For example, when the 2nd different motor from the above-mentioned motor combined with the torque control means is combined with a driving shaft and a prime mover is suspended, it is possible to take the configuration which reduces the reaction

force produced in a driving shaft with this 2nd motor. In this case, what is necessary is just to judge with the conditions that reaction force can be reduced being fulfilled, when a condition precedent judging means has the 2nd motor in the condition in which an output is possible to a driving shaft in the torque which reduces reaction force. Although the 2nd motor may be established for the purpose of reduction of the reaction force accompanying a halt of a prime mover, it may divert what was prepared in order to output and input power to a driving shaft. Since it sees from the original role of the 2nd motor in such a case and actuation called reduction of reaction force cannot be taken, it is also suitable to distinguish the operating state of the 2nd motor and to judge whether the conditions which may suspend a prime mover are satisfied.
[0018] Moreover, when the 2nd motor is combined with the driving shaft and it rotates a driving shaft to hard flow with the output shaft of a prime mover with the 2nd motor, it is also possible to judge with the conditions which a prime mover can stop being satisfied (for example, when this power output unit is carried in the vehicle and it retreats a vehicle).
[0019] In each above-mentioned configuration, when it has three shafts with which a driving shaft, an output shaft, and the revolving shaft of a motor are combined in a torque control means, respectively and power is outputted and inputted among these 3 shafts to any 2 shafts, it can consider as a 3 shaft type power I/O means to output and input the power which becomes settled based on the power outputted and inputted to one residual shaft. As such a 3 shaft type power I/O means, planetary-gear equipment, bevel-gear equipment, etc. are known. According to this configuration, a prime mover, a motor, and a driving shaft are combinable reasonable. The condition of driving a driving shaft by making only a prime mover into the source of power, the condition of driving a driving shaft by making a prime mover and a motor into the source of power, I/O of the power to each shaft is freely controllable by the bottom of the above-mentioned properties of 3 shaft type power I/O means, such as a condition which revives power from a motor, and the condition of using a prime mover as a damping device.
[0020] The prime mover to which the approach of suspending the prime mover of the invention in this application outputs power by combustion of a fuel, In the power output unit equipped with the motor which can output and input power to the torque control means which controls torque which is infixed between the output shaft of this prime mover, and a driving shaft, and is outputted to this driving shaft, and this torque control means Are the approach of suspending said prime mover, and it is based on the demand to a power output unit. Determine the operational status of said prime mover and the existence of the need of continuing operation of this prime mover is judged. Judge whether the conditions that this prime mover can be suspended are satisfied, and it is judged that it is not necessary to continue operation of the prime mover under said operation. And when judged with the conditions that this prime mover can be suspended being satisfied, while suspending the fuel supply to a prime mover, let it be a summary to perform control at the time of a halt which adds torque to said output shaft, controls the rotation deceleration of this output shaft in the predetermined range, and suspends said prime mover.
[0021] When it is judged according to the halt approach of the prime mover in this power output unit that it is not necessary to continue operation about the operational status of a prime mover, operation of a prime mover is not suspended simply, but only when it judges whether the conditions that operation of a prime mover can be suspended are satisfied and the conditions that operation of a prime mover can be suspended are satisfied, control is performed at the time of a halt of a prime mover.
[0022]
[Other modes of invention] As other gestalten of this invention, a torque control means and a motor are constituted in one. As this motor The 1st Rota combined with the output shaft of said prime mover, and the 2nd Rota pivotable [relatively] and combined with said driving shaft to this 1st Rota, The mode of the power output unit using the motor equipped with the coil which exchanges the power according to relative rotation of these 1st and 2nd Rota can be considered. Since it is also the same as when this configuration is adopted for Rota where mass is big to be combined with the output shaft of a prime mover, and to produce problems, such as torsion

resonance, the advantage which adopts the configuration of this application is large.
[0023]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on an example. It is the block diagram showing the outline configuration of the car with which the block diagram in which drawing 1 shows the outline configuration of the power output unit 110 as one example of this invention, and drawing 2 incorporated the partial enlarged drawing of the power output unit 110 of an example, and drawing 3 incorporated the power output unit 110 of an example. It explains from the configuration of the whole car using drawing 3 first on account of explanation.
[0024] This car is equipped with the engine 150 which outputs power by using a gasoline as a fuel as shown in drawing 3 . This engine 150 inhales the gaseous mixture of the air inhaled through the throttle valve 166 from the inhalation-of-air system, and the gasoline injected from the fuel injection valve 151 to a combustion chamber 152, and changes into rotation of a crankshaft 156 movement of the piston 154 depressed by explosion of this gaseous mixture. Here, the closing motion drive of the throttle valve 166 is carried out by the actuator 168. The high voltage from an ignitor 158 is led to the ignition plug 162 through the distributor 160, and a spark is formed in an ignition plug 162 to predetermined timing of this high voltage. The gaseous mixture inhaled in the combustion chamber 152 is lit by this spark, and carries out explosion combustion by it. The gas after the combustion which depressed the piston 154 by explosion combustion and rotated the crankshaft 156 is discharged from an exhaust valve to an exhaust pipe 153, and after passing a catalytic converter 155 and being purified, it is discharged by atmospheric air.
[0025] Operation of this engine 150 is controlled by the electronic control unit (hereafter referred to as EFIECU) 170. The various sensors in which the operational status of an engine 150 is shown are connected to EFIECU170. For example, it is the rotational frequency sensor 176, the angle-of-rotation sensor 178, etc. which are prepared for the coolant temperature sensor 174 and distributor 160 which detect the water temperature of the throttle-valve position sensor 167 which detects the opening (position) of a throttle valve 166, the inlet-pipe negative pressure sensor 172 which detects the load of an engine 150, and an engine 150, and detect the rotational frequency and angle of rotation of a crankshaft 156. In addition, although the starting switch 179 which detects the condition ST of an ignition key was connected to EFIECU170 in addition to this, illustration of other sensors, a switch, etc. was omitted.
[0026] It is combined with planetary gear 120, the motor MG 1, and Motor MG 2 which are later mentioned through the damper 157 which controls the amplitude of the torsional oscillation produced in a crankshaft 156, and the crankshaft 156 of an engine 150 is combined with the differential gear 114 through the power transfer gear 111 which sets a revolving shaft as a driving shaft 112 further. Therefore, finally the power outputted from the power output unit 110 is transmitted to the driving wheel 116,118 on either side. It connects with the control unit 180 electrically, and drive control of a motor MG 1 and the motor MG 2 is carried out by this control unit 180. Although the configuration of a control unit 180 is explained in full detail later, the interior is equipped with Control CPU and accelerator pedal position sensor 164a prepared in the shift position sensor 184 formed in the shift lever 182 or the accelerator pedal 164, brake-pedal position sensor 165a prepared in the brake pedal 165 are connected. Moreover, the control unit 180 is exchanging various information by EFIECU170 and the communication link which were mentioned above. About control including the exchange of such information, it mentions later.
[0027] The wheel cylinders 116a and 118a which perform that damping force are formed in a driving wheel 116,118, it gets down to it, and the ABS (anti-lock brake) equipment 140 which reduces it when a wheel locks the magnitude of the oil pressure supplied from the master wheel cylinder (not shown) interlocked with these wheel cylinders 116a and 118a at the brake pedal 165 is formed in it. When a wheel locks and slip ratio becomes superfluous, this ABS equipment 140 judges this, reduces the brake oil pressure of wheel cylinders 116a and 118a, avoids that a wheel locks, and secures the controllability of a vehicle. From this ABS equipment 140, the signal which shows [of ABS control] whether it is under activation is outputted to the control unit 180.

[0028] As shown in drawing 1 , the power output unit 110 of an example Greatly The damper 157 which connects the crankshaft 156 and the carrier shaft 127 of an engine 150 and an engine 150, and controls the amplitude of the torsional oscillation of a crankshaft 156, the planetary gear 120 by which the planetary carrier 124 was combined with the carrier shaft 127, It consists of control units 180 which carry out drive control of the motor MG 2 combined with the ring wheel 122 of the motor MG 1 combined with the sun gear 121 of planetary gear 120, and planetary gear 120, and the motors MG1 and MG2.
[0029] Drawing 2 explains the configuration of planetary gear 120 and motors MG1 and MG2. The sun gear 121 combined with the sun gear shaft 125 in the air with which planetary gear 120 penetrated the shaft center on the carrier shaft 127, The ring wheel 122 combined with the carrier shaft 127 and the ring wheel shaft 126 of the same axle, Two or more planetary pinion gears 123 which revolve around the sun while it is arranged between a sun gear 121 and a ring wheel 122 and the periphery of a sun gear 121 is rotated, It consists of planetary carriers 124 which are combined with the edge of a crankshaft 156 and support the revolving shaft of each planetary pinion gear 123 to revolve. In these planetary gear 120, 3 of the sun gear shaft 125 combined with the sun gear 121, the ring wheel 122, and the planetary carrier 124, respectively, the ring wheel shaft 126, and the carrier shaft 127 shafts are used as the I/O shaft of power, and if the power outputted and inputted among three shafts to any 2 shafts is determined, the power outputted and inputted by one residual shaft will become settled based on the power outputted and inputted biaxial [which was determined]. The detail about I/O of the power to three shafts of these planetary gear 120 is mentioned later. In addition, the resolver 139,149,159 which detects angle-of-rotation thetas, thetar, and thetac, respectively is formed in the sun gear shaft 125, the ring wheel shaft 126, and the carrier shaft 127.
[0030] The power fetch gear 128 for the ejection of power is combined with the ring wheel 122. This power fetch gear 128 is connected to the power transfer gear 111 by the chain belt 129, and transfer of power is made between the power fetch gear 128 and the power transfer gear 111.
[0031] A motor MG 1 is constituted as a synchronous motor generator, and is equipped with Rota 132 which has two or more permanent magnets 135 in a peripheral face, and the stator 133 around which the three phase coil 134 which forms rotating magnetic field was wound. Rota 132 is combined with the sun gear shaft 125 combined with the sun gear 121 of planetary gear 120. A stator 133 carries out the laminating of the sheet metal of a non-oriented magnetic steel sheet, is formed, and is being fixed to the case 119. This motor MG 1 operates as a motor which carries out the rotation drive of Rota 132 by the interaction of the field by the permanent magnet 135, and the field formed with the three phase coil 134, and operates as a generator which makes the both ends of the three phase coil 134 produce electromotive force by the interaction of the field by the permanent magnet 135, and rotation of Rota 132.
[0032] A motor MG 2 is constituted as a synchronous motor generator like a motor MG 1, and is equipped with Rota 142 which has two or more permanent magnets 145 in a peripheral face, and the stator 143 around which the three phase coil 144 which forms rotating magnetic field was wound. Rota 142 is combined with the ring wheel shaft 126 combined with the ring wheel 122 of planetary gear 120, and the stator 143 is being fixed to the case 119. The stator 143 of a motor MG 2 also carries out the laminating of the sheet metal of a non-oriented magnetic steel sheet, and is formed. It operates as a motor or a generator like [this motor MG 2] a motor MG 1.
[0033] Next, the control unit 180 which carries out drive control of the motors MG1 and MG2 is explained. As shown in drawing 1 , the control unit 180 consists of dc-batteries 194 which are the control CPU 190 and the rechargeable battery which control the 1st drive circuit 191 which drives a motor MG 1, the 2nd drive circuit 192 which drives a motor MG 2, and both the drive circuit 191,192. Control CPU 190 is one chip microprocessor, and equips the interior with RAM190a for work pieces, ROM190b which memorized the processing program, input/output port (not shown) and EFIECU170, and the serial communication port (not shown) that performs a communication link. In this control CPU 190, angle-of-rotation thetas of the sun gear shaft 125 from a resolver 139, Angle-of-rotation thetar of the ring wheel shaft 126 from a resolver 149, angle-of-rotation thetac of the carrier shaft 127 from a resolver 159, The accelerator pedal

position AP from accelerator pedal position sensor 164a (the amount of treading in of an accelerator pedal) The brake-pedal position BP from brake-pedal position sensor 165a (the amount of treading in of a brake pedal), The shift position SP from the shift position sensor 184 The remaining capacity of the current values Iu1 and Iv2 from two current detectors 195,196 prepared in the 1st drive circuit 191, the current values Iu2 and Iv2 from two current detectors 197,198 prepared in the 2nd drive circuit 192, and a dc-battery 194 The remaining capacity BRM from the remaining capacity detector 199 to detect etc. is inputted through input port.
[0034] Although the shift position sensor 184 detects the position (range) SP of the current shift lever 182, by the vehicle of this example, a parking range (P), neutral range (N), and retreat range (R), a driving range (D), and a brake range (B) are formed. Among these, although there is especially no place that P, N, R, and D range change with the usual vehicle, B range is a range original with the vehicle of this example. B range is a range which strengthened effectiveness of the regenerative brake at the time of vehicle moderation compared with D range, and when a vehicle gets down from a downward slope and goes, it is a range which performs positively regeneration by motors MG1 and MG2, and acquires a property like the engine brake in the usual vehicle by the regenerative brake. This B range is the same as D range about a vehicle acceleration side, and a property is acquired.
[0035] What the remaining capacity detector 199 measures the specific gravity of the electrolytic solution of a dc-battery 194 or the weight of the whole dc-battery 194, and detects remaining capacity, the thing which calculates the current value and time amount of charge and discharge, and detects remaining capacity, the thing which detects remaining capacity by making between the terminals of a dc-battery short-circuit momentarily, and measuring sink internal resistance for a current are known.
[0036] From control CPU 190, the control signal SW2 which drives six transistors Tr11 as the control signal SW1 which drives six transistors Tr1 which are the switching elements prepared in the 1st drive circuit 191 thru/or Tr6, and a switching element prepared in the 2nd drive circuit 192 thru/or Tr16 is outputted. Six transistors Tr1 in the 1st drive circuit 191 thru/or Tr6 constitute the transistor inverter, two pieces are arranged at a time in a pair, respectively so that it may become a source and sink side to power-source Rhine L1 and L2 of a pair, and each of the three phase coil (UVW) 34 of a motor MG 1 is connected at the node. Power-source Rhine L1 and L2 controls sequentially the rate of the transistor Tr1 which makes a pair by control CPU 190 since it connects with the plus [of a dc-battery 194], and minus side, respectively thru/or the ON time amount of Tr6 with a control signal SW1, and if the current which flows in each coil of the three phase coil 134 is made into a false sine wave by PWM control, rotating magnetic field will be formed with the three phase coil 134.
[0037] On the other hand, six transistors Tr11 of the 2nd drive circuit 192 thru/or Tr16 also constitute the transistor inverter, is arranged, respectively, and the node of the transistor which makes a pair is connected to each of the three phase coil 144 of a motor MG 2. [as well as the 1st drive circuit 191] Therefore, the transistor Tr11 thru/or the ON time amount of Tr16 which makes a pair by control CPU 190 is sequentially controlled with a control signal SW2, and if the current which flows in each coil 144 is made into a false sine wave by PWM control, rotating magnetic field will be formed with the three phase coil 144.
[0038] Actuation of the power output unit 110 of the example which explained the configuration above is explained. The principle of operation of the power output unit 110 of an example, especially the principle of torque conversion are as follows. When operating an engine 150 on the operation point P1 of an engine speed Ne and Torque Te and operating the ring wheel shaft 126 on the operation point P2 of an engine speed Nr which is different although it is the same energy as the energy Pe outputted from this engine 150, and Torque Tr, the case where carry out torque conversion and the power outputted from an engine 150 is made to act on the ring wheel shaft 126 is considered. The engine 150 at this time, the rotational frequency of the ring wheel shaft 126, and the relation of torque are shown in drawing 4 .
[0039] Three shafts of planetary gear 120 (according to the place which device study teaches, the relation between the rotational frequency in the sun gear shaft 125, the ring wheel shaft 126, and the carrier shaft 127 or torque can be expressed as drawing called the collinear Fig.

illustrated to drawing 5 and drawing 6 , and can be solved geometrically.) In addition, the rotational frequency of three shafts and the relation of torque to planetary gear 120 are also analyzable in formula by calculating the energy of each shaft etc., even if it does not use an above-mentioned collinear Fig. By this example, since explanation is easy, it explains using a collinear Fig.

[0040] The axis of ordinate in drawing 5 is a rotational frequency shaft of three shafts, and an axis of abscissa expresses the ratio of the location of the axis of coordinates of three shafts. That is, when the axes of coordinates S and R of the sun gear shaft 125 and the ring wheel shaft 126 are taken to both ends, the axis of coordinates C of the carrier shaft 127 is defined as a shaft which divides Shaft S and Shaft R interiorly to 1:rho. rho is the ratio of the number of teeth of a sun gear 121 to the number of teeth of a ring wheel 122 here, and it is expressed with a degree type (1).

[0041]

[Equation 1]

$$\rho = \frac{\text{サンギヤの歯数}}{\text{リングギヤの歯数}} \quad \cdots (1)$$

[0042] The engine 150 is operated at the rotational frequency Ne, since the case where the ring wheel shaft 126 is operated at the rotational frequency Nr is considered, the rotational frequency Ne of an engine 150 can be now plotted on the axis of coordinates C of the carrier shaft 127 with which the crankshaft 156 of an engine 150 is combined, and a rotational frequency Nr can be plotted on the axis of coordinates R of the ring wheel shaft 126. If the straight line which passes along both this point is drawn, it can ask for the rotational frequency Ns of the sun gear shaft 125 as a rotational frequency expressed on the intersection of this straight line and axis of coordinates S. Hereafter, this straight line is called a collinear of operation. In addition, it can ask for a rotational frequency Ns by the proportion equation (degree type (2)) using a rotational frequency Ne and a rotational frequency Nr. Thus, in planetary gear 120, if it opts for any two rotations among a sun gear 121, a ring wheel 122, and the planetary carrier 124, it will opt for one residual rotation based on two rotations for which it opted.

[0043]

[Equation 2]

$$Ns = Nr - (Nr - Ne)\frac{1+\rho}{\rho} \quad \cdots (2)$$

[0044] Next, the torque Te of an engine 150 is made to act on the drawn collinear of operation upwards from drawing Nakashita by making the axis of coordinates C of the carrier shaft 127 into line of action. Since a collinear of operation can be dealt with as the rigid body at the time of making the force as a vector act to torque at this time, the torque Te made to act on an axis of coordinates C is separable into the torque Tes on an axis of coordinates S, and the torque Ter on an axis of coordinates R with the technique of separation of the force to two parallel different line of action. The magnitude of Torque Tes and Ter is expressed by the degree type (3) at this time. In addition, in explanation of the following which used the collinear Fig., although each torque Tes, Te, Ter, and Tr is treated in an absolute value as what has the forward sign which is not related to the direction which acts altogether, the torque Tm1 and Tm2 which is [total] necessary shall be treated with a sign. Therefore, a sign forward [torque / Tm1] in facing down and Tm2 become a sign forward in facing up. Consequently, if torque Tm2 turns into upward torque in a collinear Fig. if it is Tr-Ter>0, and it is Tr-Ter<0, torque Tm2 turns into downward torque. It is unrelated the direction of torque Tm1 and Tm2, whether motors MG1 and MG2 have revived power, or power is consumed (power running). The condition (are you regeneration or power running?) of motors MG1 and MG2 becomes settled by whether it is acting on the side to which torque Tm1 and Tm2 accelerates the rotational frequency of the shaft on which the torque is acting, or it is acting on the side to slow down so that it may mention later.

[0045]

[Equation 3]

$$Tes = Te \times \frac{\rho}{1+\rho}$$
$$Ter = Te \times \frac{1}{1+\rho} \quad \cdots (3)$$

[0046] What is necessary is just to take balance of the force of a collinear of operation, in order for the collinear of operation to be stable in this condition. That is, magnitude is the same as Torque Tes, the torque Tm1 with the opposite sense is made to act, magnitude is the same to resultant force with torque and Torque Ter with the opposite sense on an axis of coordinates R in the same magnitude as the torque Tr outputted to the ring wheel shaft 126, and the sense makes the opposite torque Tm2 act on an axis of coordinates S. This torque Tm1 can act by the motor MG 1, and torque Tm2 can be made to act by the motor MG 2. Since torque is made to act on a rotational direction and the rotational reverse sense by the motor MG 1 at this time, a motor MG 1 will operate as a generator and revives electrical energy Pm1 expressed with the product of torque Tm1 and a rotational frequency Ns from the sun gear shaft 125. By the motor MG 2, since the direction of torque is the same as the direction of rotational, a motor MG 2 operates as a motor and is outputted to the ring wheel shaft 126 by making into power electrical energy Pm2 expressed by the product of torque Tm2 and a rotational frequency Nr.
[0047] Here, if electrical energy Pm1 and electrical energy Pm2 are made equal, all the power consumed by the motor MG 2 can be revived by the motor MG 1, and it can be provided. What is necessary is for that just to make equal the thing which outputs all the inputted energy then the energy Pe outputted from an engine 150 since it is good, and energy Pr outputted to the ring wheel shaft 126. That is, the energy Pe expressed with the product of Torque Te and a rotational frequency Ne and energy Pr expressed with the product of Torque Tr and a rotational frequency Nr are made equal. If it compares with drawing 4 , torque conversion will be carried out and the power expressed with the torque Te outputted from the engine 150 currently operated on the operation point P1 and a rotational frequency Ne will be outputted to the ring wheel shaft 126 as power expressed with the same energy at Torque Tr and a rotational frequency Nr. As mentioned above, the power outputted to the ring wheel shaft 126 is transmitted to a driving shaft 112 by the power fetch gear 128 and the power transfer gear 111, and is transmitted to a driving wheel 116,118 through a differential gear 114. Therefore, since linear relation is materialized for the power outputted to the ring wheel shaft 126, and the power transmitted to a driving wheel 116,118, the power transmitted to a driving wheel 116,118 is controllable by controlling the power outputted to the ring wheel shaft 126.
[0048] Although the engine speed Ns of the sun gear shaft 125 is forward in the collinear Fig. shown in drawing 5 , as shown in the collinear Fig. shown in drawing 6 R> 6, it may become negative at the engine speed Ne of an engine 150, and the engine speed Nr of the ring wheel shaft 126. At this time, by the motor MG 1, since the direction of rotational and the direction where torque acts become the same, a motor MG 1 operates as a motor and consumes electrical energy Pm1 expressed by the product of torque Tm1 and a rotational frequency Ns. On the other hand, by the motor MG 2, since the direction of rotational and the direction where torque acts become reverse, a motor MG 2 will operate as a generator and will revive electrical energy Pm2 expressed by the product of torque Tm2 and a rotational frequency Nr from the ring wheel shaft 126. In this case, if electrical energy Pm1 consumed by the motor MG 1 and electrical energy Pm2 revived by the motor MG 2 are made equal, electrical energy Pm1 consumed by the motor MG 1 can be exactly provided by the motor MG 2.
[0049] As mentioned above, although the fundamental torque conversion in the power output unit 110 of an example was explained The power outputted from an engine 150 besides the actuation which the power output unit 110 of an example carries out torque conversion of all the power outputted from such an engine 150, and is outputted to the ring wheel shaft 126 (product of Torque Te and a rotational frequency Ne), By adjusting electrical energy Pm1 revived or consumed by the motor MG 1, and electrical energy Pm2 consumed or revived by the motor MG

2 It can consider as the actuation which finds out excessive electrical energy and discharges a dc-battery 194, or can also consider as various actuation, such as actuation with which the electrical energy running short is compensated with the power stored in the dc-battery 194.
[0050] In addition, the above principle of operation explained the conversion efficiency of the power by planetary gear 120, a motor MG 1, a motor MG 2 and a transistor Tr1, or Tr16 as a value 1 (100%). Since it is less than one value in fact, it is necessary to make energy Pr which makes a bigger value a little than the energy Pr which outputs the energy Pe outputted from an engine 150 to the ring wheel shaft 126, or is conversely outputted to the ring wheel shaft 126 into a value [a little] smaller than the energy Pe outputted from an engine 150. For example, what is necessary is just to consider as the value computed by multiplying by the inverse number of conversion efficiency by the energy Pr outputted to the ring wheel shaft 126 in the energy Pe outputted from an engine 150. Moreover, what is necessary is to consider as the value computed from what multiplied the power revived by the motor MG 1 in the condition of the collinear Fig. of drawing 5 in the torque Tm2 of a motor MG 2 by the effectiveness of both motors, and just to compute the power consumed by the motor MG 1 in the condition of the collinear Fig. of drawing 6 from what was broken by effectiveness of both motors. In addition, although energy is lost as heat by machine friction etc. in planetary gear 120, there are very few the amounts of loss, if it sees from the amount of whole, and the effectiveness of the synchronous motor used for motors MG1 and MG2 is very close to a value 1. Moreover, very small things, such as GTO, are known also for a transistor Tr1 thru/or the on resistance of Tr16. Therefore, since it becomes a thing near a value 1, and the following explanation is also easy for explanation, the conversion efficiency of power is dealt with as a value 1 (100%), unless it shows clearly.
[0051] Next, in the car which is in a run state by such torque control, the decision routine at the time of suspending operation of an engine 150 is explained based on drawing 7 with a run state. Initiation of this routine performs processing which checks the value of the engine shutdown possible flag SXEG first (step S10). This flag SXEG is a flag which shows whether it may see from the demand to an engine 150, and an engine 150 may be suspended. This flag is set up in other routines which are not illustrated by the control device 180. As for a control device 180, a value 1 is set as the engine shutdown possible flag SXEG noting that the need of operating an engine 150 and outputting energy to the output shaft does not have the present, if the total Pe with the energy Pd which is needed on transit of a vehicle, and the energy Pb demanded for the charge and discharge of a dc-battery 194 becomes smaller than the decision value defined beforehand. On the other hand, this flag SXEG is set as a value 0 that it should start an engine 150 and should continue operation on transit if total with the required energy Pd and the energy Pb required for the charge and discharge of a dc-battery 194 becomes beyond a predetermined value.
[0052] If Flag SXEG is not a value 1, since it is not necessary to suspend an engine 150, it escapes from processing to "END" and it once ends this routine. If this flag SXEG is a value 1, from the conditions on energy balance, it will judge that an engine 150 can be suspended and decision of the condition precedent not more than step S20 will be performed. Step S From on energy balance, though an engine 150 can be suspended, also when an engine 150 cannot be suspended, by the whole vehicle, it judges whether the conditions that an engine 150 can be suspended are satisfied from a certain thing by seeing from the power output unit 110 and the device relevant to this 20 or less. Processing of these single strings is equivalent to a condition precedent judging means.
[0053] When Flag SXEG is a value 1, processing judged about the present shift range next is performed (step S20). The shift range of a vehicle can be judged with the signal from the shift position sensor 184 formed in the shift lever 182. If it is shown that the shift position SP is a parking (P) range next, a signal will be read from a resolver 149 and processing which judges whether the vehicle is moving or not will be performed (step S25). In P range, fundamentally, since a vehicle must not run, it is P range, and when the driving shaft 112 is rotating, the defect of P range lock etc. can consider that a certain fault has occurred. The engine 150 which generates the force of the advance direction on a vehicle in such a case is wanted to stop

immediately. Then, in this case, processing (step S90 mentioned later) is performed at the time of an engine shutdown, and an engine 150 is suspended. It does not interfere as what suspends an engine 150 immediately, without processing in this case, from the first, at the time of the engine shutdown of step S90, since there is possibility of generating of a certain fault. In addition, after suspending an engine 150 in such a case, it is also suitable to perform an abnormality display etc.

[0054] When the shift range of a shift lever 182 is a retreat (R) range, it judges whether SOC which shows the charge of a dc-battery 194 below is over the predetermined value S1 (this example about 45 [%]) (step S30). Furthermore, the opening TA of a throttle valve 166 is read from the throttle-valve position sensor 167, and it judges whether this is over 50 [%] (step S35). When SOC is over the predetermined value S1 and the throttle-valve opening TA is over 50 [%], it judges that an engine 150 is suspended, it shifts to step S90, and control is performed at the time of an engine shutdown. If at least one of these decision is not materialized, it judges that an engine 150 does not stop, it escapes to "END", and this routine is once ended. By this decision, the dc-battery 194 is charged to some extent, and an engine 150 will stop, when big driving force is required like retreat of a slope. Since the torque by the side of advance has arisen from the engine 150, it may become impossible to output required retreat torque to a driving shaft 112 in the power output unit 110 of this example, if the engine 150 is operated when big driving force is required. Therefore, in such a case, an engine 150 is suspended promptly. On the other hand, when SOC is small, priority is given to charge and an engine 150 is not suspended.

[0055] Next, when whether the vehicle has stopped when a shift position is judged to be in a drive-range (D) range or a brake (B) range has judged and (step S40) stopped, after stopping, it judges whether 4 seconds have passed (step S45). In D and B range, Flag SXEG is a value 1, and as long as the vehicle has moreover stopped, originally an engine 150 may be suspended. However, when the start-stop is repeated like delay transit, since the vehicle stopped is said and an engine 150 is immediately suspended since possibility of starting an engine 150 at the time of start is high, an engine 150 will be turned on and off at every start-stop, for example, and it may be sensed that turning on and off of an engine 150 is too frequent, considering an operator. In this example, when 4 seconds have passed since a vehicle halt, the feeling of frequent occurrence of turning on and off of such an engine is escaped by judging an engine 150 that a halt is possible for the first time. If 4 seconds have passed since the stop, it will judge that an engine 150 is suspended and will shift to step S90.

[0056] On the other hand, when the vehicle has not stopped, it judges whether next ABS equipment 140 is non-operating state (step S50). When a brake pedal 165 is broken in and a vehicle is braked, ABS equipment 140 controls brake oil pressure, and is outputting the signal which shows the working thing working to the control unit 180 so that a driving wheel 116,118 may not be in a lock condition with superfluous braking oil pressure. Therefore, it can judge whether a control unit 180 has working ABS equipment by reading this signal. If ABS equipment 140 is working, the damping force which joins a driving shaft 112 will be controlled, it will judge that it is not desirable to fluctuate the magnitude of the torque which suspends an engine 150 and is outputted to a driving shaft 112, and an engine 150 will not be suspended. In this case, it escapes to "END" and this routine is once ended.

[0057] On the other hand, if ABS equipment 140 is judged to un-be working, it will judge whether it is in the situation which can cancel reaction force next (step S55). When cancellation of reaction force suspends an engine 150, it means canceling by the torque to which a motor MG 2 outputs fluctuation (rapid decrease) of the torque produced in a driving shaft 112. When an engine 150 is suspended, it is because an operator may feel a torque shock at the time of a halt of an engine 150 when the torque fluctuation to produce is noncancellable driving shaft 112. Therefore, it becomes a requirement that a halt of an engine 150 is in the condition which can cancel torque fluctuation. When the motor MG 2 has revived power and is functioning as a regenerative brake, a predetermined limit may exist in the torque command value of a motor MG 2 by the demand from an electrical potential difference, a regeneration current, etc. In such a case, the torque command value of a motor MG 2 cannot be changed, and reaction force cannot be canceled. Therefore, the minimum guard value of a motor MG 2 is asked for the

predetermined value TSTP which expected the allowances for canceling reaction force, and if the torque command value of a motor MG 2 has turned into beyond this predetermined value TSTP, it can be judged that reaction force is cancellable. Gear-ratio TSD of the minimum guard value rho:planetary gear 120 of the motor MG 2 by which the predetermined value TSTP can be found from a TSTP=TLG-1.2x rhoxTSDTLG:power limit here: It is the reduction torque for reaction force cancellation (with this example - 14Nm).
It asked by carrying out. In addition, a multiplier 1.2 is a multiplier for expecting the insurance on control.
[0058] When it is judged that reaction force cancellation is possible, processing which checks the vehicle speed next is performed (step S60). If the vehicle speed is contained from 15 km/h to 45 km/h, it considers that torque fluctuation is not worried so much by control of reaction force cancellation mentioned above even if it suspends an engine 150, and when 3 seconds or more have passed since the engine 150 was suspended previously, it will shift to control (step S90) at the time of a halt of (step S70) and an engine 150. Here, because halt control of an engine 150 is not performed too much frequently, it is contingent [on progress] for 3 seconds. On the other hand, if the vehicle speed is 15 or less km/h, it will judge whether the brake is an ON state (step S65). When the vehicle speed is low, torque fluctuation of the driving shaft 112 by halt of an engine 150 may be felt also by cancellation control of reaction force, but when the damping force by the brake is acting to a driving shaft 112, since a brake achieves the duty of reaction force cancellation, it judges that an engine 150 can be suspended and control is performed at the time of an engine shutdown (step S90).
[0059] In addition, when decision of steps S40 and S50 is "NO", and when the vehicle speed is judged to be 45 or more km/h at step S60, the conditions which all suspend an engine 150 judge that it is not ready, and it escapes from them to "END", and they once end this routine. Moreover, by this example, although not shown in drawing 7 , also when the shift position SP is except N range and a **** limit cannot be protected, the engine 150 is suspended. A **** limit is a limit produced from limit of the rotational frequency of each shaft of planetary gear 120 that an engine 150 and two motors MG1 and MG2 are combined. Although it already explained that actuation of planetary gear 120 could be shown using a collinear Fig. (refer to drawing 5 and drawing 6), the rotational frequency of one shaft of planetary gear 120 will be automatically decided as other biaxial rotational frequencies being decided. Since an upper limit rotational frequency exists in a sun gear 121 or a ring wheel 122, respectively, if the rotational frequency of a driving shaft 112, as a result a ring wheel 122 was decided from the vehicle speed, an engine 150 cannot be rotated only in the range in which the rotational frequency of a motor MG 1, as a result a sun gear 121 does not exceed an upper limit rotational frequency. Therefore, from this **** limit, when the engine speed of an engine 150 becomes below that independence engine speed (an example about 800 rpm), an engine 150 is suspended, for example. In N range, since shut [the motor MG 1], such conditions do not exist. The field of the **** limit to drawing 8 was shown.
[0060] According to the example explained above, control is performed the following condition at the time of a halt of an engine 150. In addition, the general conditions which suspend an engine 150 shall be ready from the charge condition of a dc-battery 194 etc. as a premise (SXEG=1).
(1) When the shift position SP is P range and a vehicle moves, perform control at the time of a halt of an engine 150, and suspend an engine 150. In P range, originally, a vehicle suspends the engine 150 which is the source of the power which advances a vehicle noting that a certain fault exists when a vehicle moves since it does not run.
[0061] (2) In the case of R range, SOC is below a predetermined value, and when the throttle opening TA is more than 50 [%], perform control which suspends an engine 150. An engine 150 is suspended when strong torque is required like [the vehicle is retreating and / at the time of the climb by retreat]. It is because the case where required torque cannot be taken out at a driving shaft 112 at the time of retreat if the engine 150 is operated when, as for an engine 150, the transit direction of a vehicle has generated the torque of the reverse sense and the torque beyond a predetermined value is required of a driving shaft 112 like the climb in retreat can be considered. A vehicle can be retreated by suspending an engine 150, using the power of the

motor MG 2 driven with the power from a dc-battery 194 as it is. In addition, since the value of SOC is supervised, if the charge of a dc-battery 194 is low, since priority is given to evasion of the overdischarge of a dc-battery 194 over retreating a vehicle, a halt of an engine 150 will not be performed.
[0062] (3) When a vehicle is stopping, after stopping in the case of D or B range, when 4 seconds or more have passed, perform control at the time of a halt of an engine 150. It is because it does not interfere even if it stops an engine 150 when the vehicle has stopped.
(4) In the case of D or B range, iABS equipment 140 does not operate, but the reaction force cancellation by the ii motor MG 2 is possible, and when the iii vehicle speed is in the range of 15 km/h to 45 km/h, perform control which suspends an engine 150. It is because control of slip ratio is not affected with ABS equipment 140 or an operator does not sense the torque shock of a halt of an engine 150, when these conditions i-iii are satisfied altogether.
[0063] In addition, among the above-mentioned conditions, about the vehicle speed, if the brake is turned on in the case of 15 or less km/h, an engine 150 will be suspended. In this case, it is because the torque shock at the time of engine 150 halt is cancelable with the damping force by the brake.
[0064] Although decision whether an engine 150 can be suspended is performed by the above processing, processing (step S90) is explained using the engine shutdown control routine illustrated below to drawing 9 at the time of the engine shutdown performed when it is judged that a halt is possible. In addition, about an engine shutdown control routine, if a prime mover is operated to a idle state, controlling the deceleration of the rotational frequency of a driving shaft in the predetermined range, no matter it may be control [what], it will not interfere. Deceleration of the rotational frequency of a driving shaft is made into the predetermined range for passing through a torsion resonance field quickly.
[0065] If the engine shutdown control routine shown in drawing 9 is performed, the control CPU 190 of a control device 180 will output the signal of engine shutdown to EFIECU170 by communication link first (step S100). EFIECU170 which received the shutdown signal of an engine 150 stops impression of the electrical potential difference to an ignition plug 162 while suspending the fuel injection from a fuel injection valve 151, and it makes a throttle valve 166 further a close by-pass bulb completely. Self-supporting operation of an engine 150 stops by such processing. If the crankshaft 156 of an engine 150 is not immediately ******(ed) according to inertia but it is left as it is even if operation is suspended, the rotational frequency of an engine 150 will become small gradually with the predetermined deceleration which becomes settled with the magnitude of the load combined with the crankshaft 156, coefficient of friction of a piston 154, etc., and a rotational frequency will be soon set to 0. Here, processing explained below is performed so that the rotational frequency of an engine 150 may fall with predetermined deceleration rather than that may fall automatically.
[0066] Control CPU 190 inputs the rotational frequency Ne of an engine 150 first (step S102). It can ask for the rotational frequency Ne of an engine 150 from angle-of-rotation thetac of the carrier shaft 127 detected by the resolver 159 prepared in the carrier shaft 127 combined through the crankshaft 156 and the damper 157. In addition, direct detection of the engine speed Ne of an engine 150 can also be carried out also by the engine-speed sensor 176 prepared for the distributor 160. In this case, control CPU 190 will receive the information on a rotational frequency Ne from EFIECU170 connected to the rotational frequency sensor 176 by communication link.
[0067] An input of the rotational frequency Ne of an engine 150 sets up the initial value of the time counter TC based on the inputted rotational frequency Ne (step S104). Here, an increment is carried out in case the repeat step S106 thru/or processing of S126 are performed, as the time counter TC is an argument used when setting up target rotational frequency Ne* of an engine 150 at step S108 mentioned later and is shown in step S106. A setup of the initial value of this time counter TC is performed using the map at the time of setting up target rotational frequency Ne* of an engine 150 by making the time counter TC into an argument, for example, the map shown in drawing 10 . As shown in drawing 10 , a setup of the time counter TC takes a rotational frequency Ne on an axis of ordinate (shaft of target rotational frequency Ne*), and is

performed by calculating the value of the time counter TC corresponding to this.
[0068] If the time counter TC is set up, the set-up time counter TC will be incremented (step S106), and target rotational frequency Ne* of an engine 150 will be set up using the map shown in this time counter TC which incremented and drawing 8 (step S108). In a setup of target rotational frequency Ne*, the time counter TC is taken on an axis of abscissa (shaft of the time counter TC), and it is carried out by asking for target rotational frequency Ne* corresponding to this. In addition, signs that it asked for target rotational frequency Ne* as "TC+1" which applied the value 1 to the initial value of the time counter TC were displayed on drawing 10 R> 0. Then, the rotational frequency Ne of an engine 150 is inputted (step S110), and torque command value Tm1* of a motor MG 1 is set up by the degree type (4) using the inputted rotational frequency Ne and set-up target rotational frequency Ne* (step S112). The 1st term of the right-hand side in a formula (5) is a proportional which negates the deflection from target rotational frequency Ne* of a rotational frequency Ne here, and the 2nd term of the right-hand side is an integral term which abolishes steady-state deviation. In addition, K1 and K2 are proportionality constants.
[0069]
[Equation 4]

$$Tm1^* \leftarrow K1\,(Ne^* - Ne) + K2\int (Ne^* - Ne)\,dt \qquad \cdots (4)$$

[0070] Then, based on a degree type (5), torque command value Tm2* of a motor MG 2 is set up using command value Tr* of torque and torque command value Tm1* of a motor MG 1 which should be outputted to the ring wheel shaft 126 (step S120). Where operation of an engine 150 is suspended, when the 2nd term of the right-hand side in a formula (5) outputs the torque of torque command value Tm1* from a motor MG 1, it is torque which acts on the ring wheel shaft 126 through planetary gear 120, and K3 is a proportionality constant. Although K3 is a value 1 if it is in the condition of balance of the collinear of operation in a collinear Fig., it becomes a value smaller than a value 1 at the transient in the case of the shutdown of an engine 150. It is because the part of the torque outputted to a transient from a motor MG 1 is used for change of movement of the system of inertia which consists of an engine 150 and a motor MG 1. What is necessary is to search for the torque (inertia torque) which multiplies the moment of inertia seen from the motor MG 1 of an above-mentioned system of inertia by the angular acceleration of the sun gear shaft 125, and is used for change of movement of a system of inertia, and just to break what subtracted this from torque command value Tm1* by gear ratio rho, in order to search for this torque correctly. In the example, since torque command value Tm1* set up by this routine was a comparatively small value, count was simplified using the proportionality constant K3. In addition, command value Tr* of the torque which should be outputted to the ring wheel shaft 126 is set up based on the demand torque configuration routine illustrated to drawing 11 based on the amount of treading in of the accelerator pedal 164 by the operator. Hereafter, the processing which sets up this torque command value Tr* is explained briefly.
[0071]
[Equation 5]

$$Tm2^* \leftarrow Tr^* - K3 \times \frac{Tm1^*}{\rho} \qquad \cdots (5)$$

[0072] The demand torque configuration routine of drawing 11 is repeatedly performed for every (for example, 8msec) predetermined time. If this routine is performed, the control CPU 190 of a control unit 180 will perform first processing which reads the rotational frequency Nr of the ring wheel shaft 126 (step S130). It can ask for the engine speed Nr of the ring wheel shaft 126 from angle-of-rotation thetar of the ring wheel shaft 126 detected by the resolver 149. Then, processing which inputs the accelerator pedal position AP detected by accelerator pedal position sensor 164a is performed (step S132). Since an accelerator pedal 164 is broken in when it senses that an operator's output torque is insufficient, the accelerator pedal position AP

corresponds to the torque which should be outputted to the ring wheel shaft 126, as a result a driving wheel 116,118. If the accelerator pedal position AP is read, processing which computes torque command value Tr* which is the desired value of the torque which should be outputted to the ring wheel shaft 126 based on the read accelerator pedal position AP and the rotational frequency Nr of the ring wheel shaft 126 will be performed (step S134). The torque which should be outputted to the ring wheel shaft 126 is computed without computing the torque which should be outputted to a driving wheel 116,118 here because it will mean that it had searched for the torque which should be outputted to a driving wheel 116,118, if the ring wheel shaft 126 searches for the torque which should be outputted to the ring wheel shaft 126, since it is mechanically combined with the driving wheel 116,118 through the power fetch gear 128, the power transfer gear 111, and the differential gear 114. In addition, in the example, the value of torque command value Tr* shall be calculated based on the map which memorized beforehand the map in which the relation between the engine speed Nr of the ring wheel shaft 126, and the accelerator pedal position AP and torque command value Tr* is shown to ROM190b, and was memorized to the read accelerator pedal position AP, the engine speed Nr of the ring wheel shaft 126, and ROM190b when the accelerator pedal position AP was read. An example of this map is shown in drawing 12 .

[0073] In this way, if torque command value Tm1* of a motor MG 1 is set up at step S112 and torque command value Tm2* of a motor MG 2 is set up at step S114 By the control routine (drawing 1313) of a motor MG 1 and the control routine (drawing 14) of a motor MG 2 which are repeatedly performed using interrupt processing for every (every [for example,] 4msec) predetermined time A motor MG 1 and a motor MG 2 are controlled so that the torque of the set-up command value is outputted from a motor MG 1 and a motor MG 2. About control of such a motor MG 1 and control of a motor MG 2, it mentions later.

[0074] It returns to drawing 9 , and the control CPU 190 of a control unit 180 performs processing which compares the rotational frequency Ne and threshold Nref of an engine 150, after asking for torque command value Tm1* of motors MG1 and MG2, and Tm2* (step S116). Here, a threshold Nref is set up as a value near the value set up as target rotational frequency Ne* of an engine 150 in processing of the operation mode by the motor MG 2. In the example, since target rotational frequency Ne* of the engine 150 in processing of the operation mode by the motor MG 2 is set as the value 0, the threshold Nref is set up as a value near the value 0. In addition, this value is a value smaller than the lower limit of the rotational frequency field where the system combined with the crankshaft 156 combined by the damper 157 and the carrier shaft 127 produces resonance phenomena. Therefore, when the engine speed Ne of an engine 150 is larger than a threshold Nref, it is still in the transient of the shutdown of an engine 150, it judges that it has not become under the lower limit of the engine-speed field which produces resonance phenomena, and return, step S106, or processing of S116 is repeated and performed to step S106. If step S106 thru/or processing of S116 are repeated and performed, the increment of the time counter TC is carried out, and since target rotational frequency Ne* of an engine 150 is set up as a smaller value based on the map shown in drawing 10 , the rotational frequency Ne of an engine 150 becomes small each time with the inclination of target rotational frequency Ne* of the map shown in drawing 10 R> 0, and the same inclination. Therefore, beyond the inclination of a natural change of the engine speed Ne when the fuel injection to an engine 150 stops the inclination of target engine-speed Ne*, then the engine speed Ne of an engine 150 can be promptly made small, and the engine speed Ne of under the inclination of a natural change of an engine speed Ne, then an engine 150 can be gently made small. In the example, since it assumes passing through the rotational frequency field which produces above-mentioned resonance phenomena, the inclination of target rotational frequency Ne* is set up beyond the inclination of a natural change of a rotational frequency Ne.

[0075] On the other hand, if the rotational frequency Ne of an engine 150 becomes below the threshold Nref, while setting the cancellation torque Tc as torque command value Tm1* of a motor MG 1 (step S118), torque command value Tm2* of a motor MG 2 is set up by the upper type (5) (step S120), and it waits to carry out predetermined time progress (step S122). Here, the cancellation torque Tc is the torque for preventing so-called undershooting [from which the

rotational frequency Ne of an engine 150 serves as a negative value]. In addition, when suspending operation of an engine 150 positively by the motor MG 1 which receives PI control, it mentioned above about the reason which the rotational frequency Ne of an engine 150 undershoots.
[0076] If predetermined time progress is carried out where the cancellation torque Tc is outputted from a motor MG 1, while setting a value 0 as torque command value Tm1* of a motor MG 1 (step S124), torque command value Tr* is set as torque command value Tm2* of a motor MG 2 (step S126), and processing of the operation mode by the motor MG 2 which does not end and illustrate this routine is performed.
[0077] Next, control of a motor MG 1 is explained based on the control routine of the motor MG 1 illustrated to drawing 13 . If this routine is performed, the control CPU 190 of a control unit 180 will perform first processing which inputs angle-of-rotation thetas of the sun gear shaft 125 from a resolver 139 (step S180), and will perform processing which searches for the electrical angle theta 1 of a motor MG 1 from angle-of-rotation thetas of the sun gear shaft 125 (step S181). In the example, since the synchronous motor of four pole pairs is used as a motor MG 1, theta1=4thetas will be calculated. Then, processing which detects the currents Iu1 and Iv1 which are flowing to U phase and V phase of the three phase coil 134 of a motor MG 1 with the current detector 195,196 is performed (step S182). Although the current is flowing to the three phase of U, V, and W, since the total is zero, it is sufficient if the current which flows to two phases is measured. In this way, coordinate transformation (three phase -2 phase-number conversion) is performed using the current of the obtained three phase (step S184). Coordinate transformation is changing into the current value of d shaft of the synchronous motor of a permanent-magnet type, and q shaft, and is performed by calculating a degree type (6). Coordinate transformation is performed in the synchronous motor of a permanent-magnet type here because it is an amount with the current of d shaft and q shaft essential when controlling torque. It is also possible to control from the first with a three phase.
[0078]
[Equation 6]

$$\begin{pmatrix} Id1 \\ Iq1 \end{pmatrix} = \sqrt{2} \begin{pmatrix} -\sin(\theta s - 120) & \sin\theta s \\ -\cos(\theta s - 120) & \cos\theta s \end{pmatrix} \begin{pmatrix} Iu1 \\ Iv1 \end{pmatrix} \quad \cdots (6)$$

[0079] Next, after changing into a biaxial current value, processing which asks for current command value Id1* of each shaft searched for from torque command value Tm1* in a motor MG 1, Iq1*, the currents Id1 and Iq1 that actually flowed on each shaft, and deflection, and calculates the electrical-potential-difference command values Vd1 and Vq1 of each shaft is performed (step S186). That is, the following formulas (7) are calculated first. Here, Kp1, Kp2, Ki1, and Ki2 are multipliers respectively. These multipliers are ****** adjusted so that the property of the motor to apply may be suited. In addition, the electrical-potential-difference command values Vd1 and Vq1 are calculated from the part (the 1st term of the formula (7) 1st type right-hand side) proportional to deflection **I with current command value I*, and an accumulated part (the 2nd term of this right-hand side) of the past of i batch of deflection **I.
[0080]
[Equation 7]

$$Vd1 = Kp1 \cdot \Delta Id1 + \Sigma Ki1 \cdot \Delta Id1$$
$$Vq1 = Kp2 \cdot \Delta Iq1 + \Sigma Ki2 \cdot \Delta Iq1 \quad \cdots (7)$$

[0081] Then, coordinate transformation (two phase -3 phase-number conversion) equivalent to the inverse transformation of the conversion which performed the electrical-potential-difference command value calculated in this way at step S184 is performed (step S188), and processing which asks for the electrical potential differences Vu1, Vv1, and Vw1 actually impressed to the three phase coil 134 is performed. It asks for each electrical potential difference by the degree type (8).

[0082]
[Equation 8]

$$\begin{bmatrix} Vu1 \\ Vv1 \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} \cos\theta s & -\sin\theta s \\ \cos(\theta s-120) & -\sin(\theta s-120) \end{bmatrix} \begin{bmatrix} Vd1 \\ Vq1 \end{bmatrix}$$

$$Vw1 = -Vu1 - Vv1 \qquad \cdots (8)$$

[0083] Since actual armature-voltage control is made by the transistor Tr1 of the 1st drive circuit 191 thru/or the on-off time amount of Tr6, it carries out PWM control of each transistor Tr1 thru/or the ON time amount of Tr6 so that it may become each electrical-potential-difference command value calculated by the formula (8) (step S199).
[0084] If the sense of the torque [in / for the sign of torque command value Tm1* of a motor MG 1 / the collinear Fig. of drawing 5 or drawing 6] Tm1 is made forward here Even if torque command value Tm1* of the same forward value is set up, when the sense on which torque command value Tm1* acts like the condition of the collinear Fig. of drawing 5 differs from the sense of rotation of the sun gear shaft 125, regenerative control is made, and power running control is made like the condition of the collinear Fig. of drawing 6 at the time of the same direction. However, since power running control of a motor MG 1 and regenerative control control the transistor Tr1 of the 1st drive circuit 191 thru/or Tr6 so that forward torque acts on the sun gear shaft 125 by the permanent magnet 135 attached in the peripheral face of Rota 132, and the rotating magnetic field produced according to the current which flows in the three phase coil 134 if torque command value Tm1* is forward, they turn into the same switching control. That is, if the sign of torque command value Tm1* is the same, even if control of a motor MG 1 is regenerative control and it is power running control, it will become the same switching control. Therefore, all of the regenerative control and power running control by the control routine of the motor MG 1 of drawing 13 can be performed. Moreover, since the direction of change of angle-of-rotation thetas of the sun gear shaft 125 read at step S180 only becomes reverse when torque command value Tm1* is negative, the control routine of a motor MG 1 which illustrated to drawing 13 also at this time can be used as it is.
[0085] Next, control of a motor MG 2 is explained based on the control routine of the motor MG 2 illustrated to drawing 14 . control processing of a motor MG 2 -- control processing of a motor MG 1 -- it replaces with torque command value Tm1* and angle-of-rotation thetas of the sun gear shaft 125 inside, and is completely the same as that of control processing of a motor MG 1 except for the point using torque command value Tm2* and angle-of-rotation thetar of the ring wheel shaft 126. Namely, while detecting angle-of-rotation thetar of the ring wheel shaft 126 using a resolver 149 (step S190) The electrical angle theta 2 of a motor MG 2 is computed from detected angle-of-rotation thetar (step S191). Then, each phase current of a motor MG 2 is detected using the current detector 197,198 (step S192). Then, the operation of coordinate transformation (step S194) and the electrical-potential-difference command values Vd2 and Vq2 is performed (step S196). Furthermore, backseat label conversion (step S198) of an electrical-potential-difference command value is performed, the transistor Tr11 of the 2nd drive circuit 192 of a motor MG 2 thru/or the on-off control time amount of Tr16 are found, and PWM control is performed (step S199).
[0086] Although power running control of the motor MG 2 is carried out by the sense of torque command value Tm2*, and the sense of rotation of the ring wheel shaft 126 here or regenerative control is carried out, both power running control and regenerative control can be performed by control processing of the motor MG 2 of drawing 12 like a motor MG 1. In addition, in the example, the sign of torque command value Tm2* of a motor MG 2 made forward the sense of the torque Tm2 at the time of the condition of the collinear Fig. of drawing 5 .
[0087] Next, the situation of change, such as the rotational frequency Ne of the engine 150 in the case of halt control of such an engine 150 and the torque Tm1 of a motor MG 1, is explained using the explanatory view illustrated to the collinear Fig. illustrated to drawing 15 thru/or drawing 17 , and drawing 18 . Drawing 15 is a collinear Fig. when the engine shutdown control

routine of drawing 9 begins and is performed, drawing 16 is a collinear Fig. when step S106 of an engine shutdown control routine thru/or processing of S116 are performed repeatedly several times, and drawing 1717 is a collinear Fig. when the rotational frequency Ne of an engine 150 becomes below the threshold Nref. In the example, since the inclination of target rotational frequency Ne* in the map of drawing 10 is set up beyond the inclination of a natural change of a rotational frequency Ne, as shown in drawing 15 and drawing 16 , the torque Tm1 outputted from a motor MG 1 acts in the direction which makes the rotational frequency Ne of an engine 150 small compulsorily. Therefore, since the rotational frequency Ns of the sun gear shaft 125 serves as a negative value as it operates as a generator and is shown in drawing 16 after that, since torque Tm1 serves as a hand of cut of the sun gear shaft 125, and reverse sense when an engine shutdown control routine begins and is performed, a motor MG 1 will operate as a motor. Since the PI control of the motor MG 1 is carried out based on the rotational frequency Ne of an engine 150, and target rotational frequency Ne* at this time, as it is shown in drawing 18 , the rotational frequency Ne of an engine 150 is late for target rotational frequency Ne* a little, and it changes. In addition, since the rotational frequency Ns of the sun gear shaft 125 may serve as a negative value as explained using drawing 6 depending on the rotational frequency Ne of an engine 150 and the rotational frequency Nr of the ring wheel shaft 126 in the condition before directions of the shutdown of an engine 150 are outputted, the collinear Fig. of drawing 16 may turn into a collinear Fig. when an engine shutdown control routine is performed for the first time. In this case, a motor MG 1 will operate as a motor from the start.

[0088] Since the fuel supply to an engine 150 stops in the condition of the collinear Fig. of such drawing 15 and drawing 16 , there is no output of the torque from an engine 150. However, since torque Tm1 is outputted in the direction which makes the rotational frequency Ne of an engine 150 small compulsorily from a motor MG 1, the torque Tsc as the reaction will act on the carrier shaft 127. On the other hand, the torque Tsr outputted to the ring wheel shaft 126 through planetary gear 120 in connection with the torque Tm2 outputted from a motor MG 2 and the torque Tm1 outputted from a motor MG 1 acts on the ring wheel shaft 126. Although the torque Tsr which acts on this ring wheel shaft 126 can be searched for from change of movement of the system of inertia which consists of an engine 150 and a motor MG 1, and balance of a collinear of operation as mentioned above, it is comparable as the 2nd term of the right-hand side of a formula (5). Therefore, torque in general equal to torque command value Tr* will be outputted to the ring wheel shaft 126.

[0089] If the rotational frequency Ne of an engine 150 becomes below the threshold Nref as a result of performing the engine shutdown control routine of drawing 9 repeatedly (step S116), since the cancellation torque Tc is outputted from a motor MG 1, it will stop without producing undershooting [which was shown in drawing 18 with the broken line], and the rotational frequency Ne of an engine 150 will shift to processing of the operation mode by the motor MG 2 smoothly. In the example, torque command value Tm1* of a motor MG 1 is made into the value 0 at the time of the operation mode by this motor MG 2. For this reason, a collinear of operation settles in the smallest condition of the sum of energy required for making energy and Motor MG 1 required for making an engine 150 idle idle. In the example, the energy which friction, compression, etc. of energy required for making an engine 150 idle since the engine 150 uses the gasoline engine, i.e., the piston of an engine 150, take becomes larger than energy required for making Rota 132 of a motor MG 1 idle. Therefore, an engine 150 stops and a collinear of operation will be in the condition that a motor MG 1 idles, as shown in the collinear Fig. of drawing 17 . In addition, in the collinear Fig. of drawing 17 , the cancellation torque Tc outputted from a motor MG 1 was indicated.

[0090] According to the power output unit 110 of an example explained above, after it can judge exactly whether an engine 150 can be suspended on the conditions mentioned already and there are moreover directions of the shutdown of an engine 150, the rotational frequency Ne of an engine 150 can be quickly made into a value 0. Therefore, the rotational frequency of the field which produces the resonance phenomena of the torsional oscillation which made the engine 150 and the motor MG 1 the inertia mass can be passed quickly. Consequently, the damper 157 which controls the amplitude of torsional oscillation can be made into the thing of a simple

configuration.
[0091] Moreover, according to the power output unit 110 of an example, since the cancellation torque Tc of the direction which the engine speed Ne of an engine 150 increases just before the engine speed Ne of an engine 150 becomes a value 0 is outputted from a motor MG 1, it can control undershooting [of the engine speed Ne of an engine 150]. Consequently, generating of vibration which may be produced by undershooting, an allophone, etc. can be prevented.
[0092] Next, the 2nd example of this invention is explained. the point of performing processing shown in drawing 19 as decision whether the power output unit of the 2nd example being equipped with the same configuration as the 1st example, and an engine 150 being suspended -- things -- ** That is, in the 2nd example, when the request which continues operation of an engine 150 disappears from conditions, such as SOC of a dc-battery 194, a control device 180 checks, when that and Flag SXEG are values 1 first (step S200), and performs processing which reads the cooling water temperature Tw of an engine 150 from a coolant temperature sensor 174 next (step S210). Since it is the parameter which has the pre-heating condition of an engine 150, and strong correlation for the cooling water temperature Tw of an engine 150, the cooling water temperature Tw for getting to know the pre-heating condition of an engine 150 is read.
[0093] Then, the cooling water temperature Tw judges whether it is larger than the predetermined value T0 (this example 70 degrees C) (step S220), if the cooling water temperature Tw is larger than the predetermined value T0, it will be judged as pre-heating completion and control will be performed at the time of an engine shutdown (step S290). Control is the same as control (drawing 7 step S90) of the 1st example at the time of an engine shutdown, and since the detail was already explained using drawing 9 thru/or drawing 18 , the explanation is not repeated here. In addition, nothing is performed, but it escapes to "END", and this routine is once ended noting that pre-heating will not yet be completed, if the cooling water temperature Tw is less than [predetermined value T0].
[0094] In the power output unit of the 2nd example which performs the above-mentioned processing, even if the request which continues operation of an engine 150 is lost, control (step S290) which suspends an engine 150 is not performed until the pre-heating is completed. It can follow, for example, pre-heating of a catalytic converter 155 can fully be performed, and exhaust air purification nature is not spoiled. Moreover, although the friction of a prime mover may be large and it may be difficult to control the rotation deceleration of the output shaft of an engine 150 in the predetermined range since the lubricity of an engine 150 is inadequate if it is before pre-heating completion At this example, since an engine 150 is suspended after completing pre-heating, it is the same as that of the 1st example that an engine 150 can be suspended controlling rotation deceleration in the predetermined range, and the problem of torsion resonance can be avoided.
[0095] In the power output unit 110 of some examples explained above, although PM form (permanent magnet form-ermanent Magnet type) synchronous motor was used for the motor MG 1 and the motor MG 2, if the both sides of regeneration actuation and a powering movement are possible, VR form (adjustable reluctance form; Variable Reluctance type) synchronous motor, a vernier motor, a direct current motor, an induction motor, a superconducting motor, a step motor, etc. can also be used.
[0096] Moreover, in the power output unit 110 of an example, although the transistor inverter was used as 1st and 2nd drive circuits 191,192, an IGBT (insulated-gate bipolar mode transistor; Insulated Gate Bipolar mode Transistor) inverter, a thyristor inverter, an electrical-potential-difference PWM (pulse-width-modulation-ulseWidth Modulation) inverter, a square wave inverter (an electrical-potential-difference form inverter, current form inverter), a resonance inverter, etc. can also be used.
[0097] Furthermore, as a dc-battery 194, although Pb dc-battery, a NiMH dc-battery, Li dc-battery, etc. can be used, it can replace with a dc-battery 194 and a capacitor can also be used.
[0098] As mentioned above, although the gestalt of operation of this invention was explained, as for this invention, it is needless to say that it can carry out with the gestalt which is not limited to the gestalt of such operation at all, and becomes various within limits which do not deviate from the power output unit of an example from the summary of this inventions, such as means of

transportation, modes carried in various industrial machines etc. in addition to this, such as a vessel and an aircraft.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the outline configuration of the power output unit 110 as one example of this invention.
[Drawing 2] It is the partial enlarged drawing of the power output unit 110 of an example.
[Drawing 3] It is the block diagram which illustrates the configuration of the outline of the car incorporating the power output unit 110 of an example.
[Drawing 4] It is a graph for explaining the principle of operation of the power output unit 110 of an example.
[Drawing 5] It is the collinear Fig. showing the rotational frequency of three shafts and the relation of torque which were combined with the planetary gear 120 in an example.
[Drawing 6] It is the collinear Fig. showing the rotational frequency of three shafts and the relation of torque which were combined with the planetary gear 120 in an example.
[Drawing 7] It is the flow chart which shows the engine shutdown decision manipulation routine in an example.
[Drawing 8] It is an explanatory view explaining the **** limit in the system of an example.
[Drawing 9] It is the flow chart which illustrates the engine shutdown control routine performed by the control device 180 of an example.
[Drawing 10] It is the map which illustrates the relation between the time counter TC and target rotational frequency Ne* of an engine 150.
[Drawing 11] It is the flow chart which illustrates the demand torque configuration routine performed by the control device 180 of an example.
[Drawing 12] It is the explanatory view which illustrates the relation between the engine speed Nr of the ring wheel shaft 126, and the accelerator pedal position AP and torque command value Tr*.
[Drawing 13] It is the flow chart which illustrates the control routine of the motor MG 1 performed by the control CPU 190 of a control device 180.
[Drawing 14] It is the flow chart which illustrates the control routine of the motor MG 2 performed by the control CPU 190 of a control device 180.
[Drawing 15] It is a collinear Fig. when the engine shutdown control routine of drawing 7 begins and is performed.
[Drawing 16] It is a collinear Fig. when step S106 of an engine shutdown control routine thru/or processing of S116 are performed repeatedly several times.
[Drawing 17] It is a collinear Fig. when the rotational frequency Ne of an engine 150 becomes below the threshold Nref.
[Drawing 18] It is the explanatory view which illustrates the situation of change of the rotational frequency Ne of an engine 150, and the torque Tm1 of a motor MG 1.
[Drawing 19] It is the flow chart which shows the engine shutdown decision manipulation routine in the 2nd example.
[Description of Notations]
110 -- Power output unit
111 -- Power transfer gear

112 -- Driving shaft
114 -- Differential gear
116,118 -- Driving wheel
117,119 -- Driving wheel
119 -- Case
120 -- Planetary gear
121 -- Sun gear
122 -- Ring wheel
123 -- Planetary pinion gear
124 -- Planetary carrier
125 -- Sun gear shaft
126 -- Ring wheel shaft
127 -- Carrier shaft
128 -- Power fetch gear
129 -- Chain belt
132 -- Rota
133 -- Stator
134 -- Three phase coil
135 -- Permanent magnet
139 -- Resolver
140 -- ABS equipment
142 -- Rota
143 -- Stator
144 -- Three phase coil
145 -- Permanent magnet
149 -- Resolver
150 -- Engine
151 -- Fuel injection valve
152 -- Combustion chamber
153 -- Exhaust pipe
154 -- Piston
155 -- Catalytic converter
156 -- Crankshaft
157 -- Damper
158 -- Ignitor
159 -- Resolver
160 -- Distributor
162 -- Ignition plug
164 -- Accelerator pedal
164a -- Accelerator pedal position sensor
165 -- Brake pedal
165a -- Brake-pedal position sensor
166 -- Throttle valve
167 -- Throttle-valve position sensor
168 -- Actuator
170 -- EFIECU
172 -- Inlet-pipe negative pressure sensor
174 -- Coolant temperature sensor
176 -- Rotational frequency sensor
178 -- Angle-of-rotation sensor
179 -- Starting switch
180 -- Control unit
182 -- Shift lever
184 -- Shift position sensor

190 -- Control CPU
190 a--RAM
190 b--ROM
191 -- 1st drive circuit
192 -- 2nd drive circuit
194 -- Dc-battery
195,196 -- Current detector
197,198 -- Current detector
199 -- Remaining capacity detector
310 -- Power output unit
CS -- Crankshaft
DNP -- Damper
EG -- Engine
MG1 -- Motor
MG2 -- Motor
Tr1-Tr6 -- Transistor
Tr11-Tr16 -- Transistor

[Translation done.]